

GLOBAL AND CONTINENTAL REFERENCE SYSTEMS – HOW CAN WE RELATE THESE?

THE INTERNATIONAL GPS SERVICE CONTRIBUTIONS TO THE INTERNATIONAL
TERRESTRIAL REFERENCE FRAME

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ABSTRACT

The International GPS Service (IGS) produces Global Positioning System (GPS) data and products at the highest level of precision available, with precision GPS orbits and sub-centimeter station positioning and velocities determined globally. A goal of the IGS is to provide users anywhere in the world access to the precise International Terrestrial Reference Frame (ITRF) as well as to densify and contribute to gradual improvements in the ITRF, such as ITRF 2000. GPS is a powerful and economical tool to support the transition of national geodetic networks to current technical standards, enabling modernization of national datums while providing the link to the global reference frame of the ITRF. The most effective way to achieve a continental reference system that is robust and globally consistent is through GPS technology, reliant on the IGS infrastructure and employing the technique of combining network solutions through the SINEX approach. The International Association of Geodesy (IAG) and IGS strongly support a new initiative to establish such a continental reference system for Africa titled 'AFREF'. This paper will provide a brief description of the IGS, the current quality and availability of IGS products and applications. Concepts and examples for realizing a continental reference system will be described along with the benefits of such a system.

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The International GPS Service (IGS) produces Global Positioning System (GPS) data and products at the highest level of precision available. GPS orbits available from the IGS are consistently at the 5 centimeter level, 3d-wrms (three-dimensional weighted root mean square error), with sub-centimeter station positioning and velocities determined globally. The IGS was officially established in 1994 when it was approved as a service of the International Association of Geodesy (IAG). At this time it was evident that rapidly evolving GPS user technology combined with the resources and infrastructure of the growing IGS could significantly benefit the global realization of a truly consistent, homogenous and robust global reference system. The IGS expertise in continually exploiting the potential accuracies of the GPS result in increasing contributions to and support of the International Terrestrial Reference Frame (ITRF) of the International Earth Rotation Service (IERS). The IERS is a sister service within the IAG. A goal of the IGS is to provide users methodology and information resources to access the precise ITRF as well as to densify and contribute to gradual improvements in the ITRF.

In the late 1980's and early 1990's, the general approach to precision GPS network processing was for a simultaneous solution of all data. As the GPS network growth outpaced computer processor and memory capabilities, the concept of combination of solutions was developed and enabled through 'Solution Independent Exchange' format or SINEX. Since 1994 the IGS has developed this strategy for the combination of GPS network solutions primarily to ensure consistency in realizing positions and velocities within the defined global reference frame. Rigorous definition of these SINEX files permit different analysis groups to exchange and combine solutions from GPS networks, fully relating positions between the independent networks. This concept is now extensible to include solutions from other space geodetic techniques: Very Long Baseline Interferometry (VLBI), satellite laser ranging (SLR), the Russian GLONASS satellite observations and the French system Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS).

The most effective way to achieve a continental reference system that is robust and globally consistent is through the technology of the GPS. The explosive growth of GPS applications and the economics of GPS make this the technique of choice for sustainable geodetic operations. The key advantages of GPS in this context are being able to realize a precise geocentric reference frame within the ITRF that meets the requirements of the most demanding geodetic and geodynamics projects. Due to improvements in the GPS defined World Geodetic System 1984 (WGS84), it is now very close to the ITRF and therefore an ITRF based continental system can be used for both precision applications as well as navigation. And a modern continental reference system becomes the basis for multinational digital data sets (and inherent applications), as opposed to multiple national datums.

GPS is a powerful and economical tool to support the transition of national networks to current technical standards, enabling modernization of these national datums while providing the link to the global reference frame. The IAG and IGS strongly support a new initiative to establish such a continental reference system for Africa called 'AFREF'. Due to the permanent global infrastructure of the IGS, a flexible approach can be designed to accomplish such a system for Africa. The South American reference system 'SIRGAS' and the European system 'EUREF' are examples of what can be achieved on a continental basis through GPS.

This paper will provide a brief description of the IGS, the current quality and availability of IGS products and applications. The concepts for realizing a continental reference system will be described along with the benefits of such a system.